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THE EFFECT OF FACILITATORY AND INHIBITORY INSTRUCTIONS UPON SALIVARY CONDITIONING

by

Sara Rhine Feather

Department of Psychology
Duke University

Date: 4-24-67

Approved:

Gregory A. Kimble, Supervisor

Edward E. Jones

Larry W. Thompson

A dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor of
Philosophy in the Department of Psychology
in the Graduate School of Arts and
Sciences of Duke University

1967

ABSTRACT

(Psychology-Experimental)

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ABSTRACT

Although the conception of the conditioned response has changed radically since Pavlov's day, the notion persists that some involuntary reflexes such as salivary secretion can be conditioned relatively independently of attitudinal or voluntary influence. This assumption contrasts with the widespread belief that the unconditioned salivary response can be brought under voluntary control readily, although indirectly, by certain symbolic processes, such as thoughts of a nice, juicy steak. A review of the literature fails to uncover adequate experimental investigation of these assumptions as they pertain to salivation, but recent developments in salivary conditioning techniques make a new investigation seem warranted. The present study focuses primarily on the first assumption, namely, on whether subjects can influence their conditioned salivary response by voluntary mental effort, but some information bearing on the second assumption is obtained as a secondary feature of the study.

Two experiments were conducted in which the independent variable consisted of facilitatory and inhibitory instructions asking subjects to increase or decrease salivation, respectively, by making a mental effort to a repeated signal. The dependent variable was the difference between the average magnitude of the

salivary response to the signal (CS) and the average response magnitude during comparable sampling periods. Only trials during which there was no appreciable motor activity of the mouth or tongue were used.

In the first experiment 22 facilitatory and 26 inhibitory subjects each were given 10 conditioning trials, which consisted of a tone (CS) followed in 10 sec by 3 cc of 0.5% citric acid (US). All trials were administered automatically by timing and programming equipment at an intertrial interval directly dependent upon the subject's ongoing salivary rate. The instructions proved to be a significant factor affecting conditioning performance. Subjects who received the facilitatory instructions showed significant CR acquisition, while those who received inhibitory instructions showed hardly any evidence of conditioning.

The second experiment replicated this instructional effect and extended the finding to a different subject population, a more effective US, a different experimental laboratory, and a slightly different experimental procedure. The second experiment also asked whether instructions could affect salivary rate to the CS when that CS was never followed directly by the US. Four groups of 18 subjects were employed in a 2 x 2 design to compare the effect of facilitatory and inhibitory instructions upon salivary response to the CS of subjects who received either a paired or a nonpaired CS and US schedule. All subjects received 10 CSs (tones) and 10 USs (3 cc of 0.3% acetic acid), and all subjects were informed in advance of whether or not the

CS would be paired with the US.

The results indicated that instructions had a highly significant effect upon salivary response to the CS in the same direction as in the earlier experiment, although this effect was limited mainly to the two conditioning groups. Instructions had only a minimal effect on response when the CS was not paired with the US, in contradiction to the common belief that such control is possible.

The most important finding of the experiment for conditioning theory was that the instructional effect was much more significant than the effect of stimulus pairing, and accounted for twice as much of the between-groups variance. That a non-associative factor should be more effective than an associative factor has little precedence in studies of classical conditioning. Stimulus pairing was an important factor for subjects who had received facilitatory instructions, as earlier studies indicated it to be when no instructions were given, but stimulus pairing was not important for subjects who had received inhibitory instructions.

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There are many others whose help I greatly appreciate, among them Mrs. Melba Houser and Mrs. Edna Bissette for their typing assistance, Mrs. Mary Jane Huneycutt for her aid in rechecking the data, Mr. Fred Delse for his assistance in the execution of the first experiment, and Mr. David Wells for his tireless efforts with the recalcitrant equipment.

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S. R. F.

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THE EFFECT OF FACILITATORY AND INHIBITORY INSTRUCTIONS UPON SALIVARY CONDITIONING

INTRODUCTION

Whenever in any scientific endeavor certain findings are accepted uncritically and their implications overgeneralized, as were Pavlov's results with dogs, there is apt to follow a long, slow recovery period during which many implicit assumptions derived during the earlier period have to be isolated and independently re-evaluated. One of these assumptions which has persisted in some areas of psychology since the Pavlovian era is that there are some conditioned reflexes in humans which are relatively independent of voluntary or attitudinal control. The present thesis examines this assumption with respect to the classical conditioning of the human salivary response.

A review of the literature has failed to uncover any previous experimental work which specifically asks the subject voluntarily to influence his salivary response in the classical conditioning situation. The most nearly comparable research is that in which Razran (1935) found that subjects (N = 3) who were instructed to form associations between the conditioned stimulus (CS) and the unconditioned stimulus (US) did give larger and more stable salivary responses than did subjects (N = 3) who were instructed not to form such associations. On

the basis of this and similar work, Razran has persisted in warning of the possible interference of central factors on the underlying "pure" conditioning process. He advocates the approach of bypassing possible attitudinal factors by using cover tasks to disguise the true nature of the conditioning task from the subject. If one assumes that there is a "pure" conditioning process separable from perceptual or cognitive accompaniments, this approach might be advisable. But, if one views the subject's set toward the task as a class of determining variables lying within the system, or simply questions what the relationship to the conditioning process might be, then the direct study of the two processes together would seem advisable.

Before the question of voluntary factors and salivary conditioning can be considered, it will be necessary to consider the status of human salivary conditioning by itself. The fact is that, despite the rich legacy of Pavlov's experimental findings on conditioned salivation in dogs, almost nothing reliable is known about the conditioned salivary response in human subjects. Few experimenters have attempted research in this area and of those who have, few have obtained clearcut evidence of conditioning. Numerous technical problems have characterized the attempts to obtain an accurate index of salivary flow in human subjects. Wide variation between subjects and between trials for individual subjects is characteristic of the ongoing salivary response and provides as much of a measurement problem as it does for any of the autonomic responses.

In recent years at Duke University, however, a solution

has been reached for the more crucial methodological obstacles and several experiments now have been completed (Feather, 1967; Feather, Delse, and Bryson, 1967) which provide reliable evidence of human salivary conditioning. Only since this basic step has it become possible to consider the role of voluntary factors in salivary conditioning in a way which would give a meaningful answer.

As a background for the present work, it is informative to consider how comparable studies have proceeded with other, more frequently studied responses. Research on attitudinal factors in conditioning generally has involved the use of instructions as the independent variable, and these have been directed (1) at informing the subject how to respond, or (2) at informing the subject about the nature of the stimulus situation. The former approach is considered the most relevant for the present research because it focuses directly upon the reactional state of the subject (i.e., voluntary set or intention). For reasons which are not entirely clear, this direct approach has been limited almost exclusively to studies of skeletal responses, such as the eyeblink or finger withdrawal, until the present application to the salivary response.

Studies of the effect of instructions on eyelid conditioning (Miller, 1939; Norris and Grant, 1948; Nicholls and Kimble, 1964) have indicated that when subjects are given inhibitory instructions not to blink "until the airpuff strikes your eye," there is a depressed rate and magnitude of conditioned responses (CRs), whereas when given neutral instructions

to "relax and let your eye movements take care of themselves," there is a much higher rate and level of CRs attained. When subjects are given voluntary instructions which ask them to blink to the CS directly, there is an even more rapid and higher level of eyeblink responses (Gormezano and Moore, 1962), but these responses appear to be of a different form and latency than those which occur in the typical conditioning experiment or following the other instructions. In summary, it would appear that verbally induced sets aroused by instructions influence to a great extent the type and the number of eyelid responses which appear, although they do not determine completely the eyelid conditioning process.

Research on the relationship between attitudinal factors and autonomic responses generally has stemmed from a different viewpoint. Some theorists (Mowrer, 1938) suggest that the conditioning process consists essentially of a state of expectancy which develops gradually as a function of associative experience in the conditioning situation. This reasoning suggests that if the state of expectancy could be developed immediately, by instructions for instance, then the stimulus pairing or associative experience would be unnecessary for conditioning to occur. In a typical design of this type, subjects were told they would receive a shock (US) following a tone (CS), and then before any stimulus pairing had occurred, a significant increase in the magnitude of the galvanic skin response (GSR) was observed (Cook and Harris, 1937).

An unsettled issue for conditioning theorists (Kimble,

1967, pp. 94-96) is the interpretation of this type of response, however. Are these responses classically conditioned within the situation, or are they responses which earlier were acquired to the meaning of the word "shock" and which are transferred to the present situation? Intertwined with these issues is the question of possible skeletal-response mediation which could remove the issue from one of conditioning altogether, at least for the autonomic response under consideration. For instance, as Smith (1967) has suggested, the alteration in autonomic response might be actually a secondary and unlearned effect of changes in the skeletal musculature.

Answers to these questions must await further research, but it might be expeditious to abandon this complicated indirect approach of manipulating the subject's set and study response factors more directly. With one exception, there has been no research on the voluntary control of a classically conditioned autonomic response until the present study, although recent attempts to condition the GSR and heart-rate responses by instrumental techniques may represent a similar trend (Fowler and Kimmel, 1962; Kimmel and Kimmel, 1963; Crider, Shapiro, and Tursky, 1966). There is one recent study on the classical conditioning of the GSR which does pave the way for the present study on salivation. Hill (1966) found that cleverly worded instructions encouraging some subjects to allow themselves to be conditioned led to a significantly higher magnitude of response and greater resistance to extinction than did instructions encouraging other subjects to resist such conditioning. The pre-

sent study represents another such attempt to approach directly the possible role of voluntary factors in the conditioning of an autonomic response.

Purpose of the Present Studies

The present work was the outgrowth of earlier studies (Feather, 1967) which sought to demonstrate the occurrence of human salivary conditioning with various types of controls. One of the main reasons that this original work was undertaken, as Feather states (1967, p. 118), was because of the hope that the salivary reflex might be influenced relatively little by voluntary and attitudinal variables. After the basic studies demonstrating the acquisition of salivary response independent of sensitization or pseudoconditioning, it was logical to check on this original assumption.

The purpose of the present studies was to determine whether the course of salivary conditioning could be influenced by giving some subjects facilitatory instructions asking them to increase their rate of salivation to the CS, while giving other subjects inhibitory instructions asking them to inhibit salivation to the CS. All subjects were informed of the stimulus contingencies (i.e., whether or not the CS would be followed by the US) in an effort to insure homogeneity of expectation among subjects. The research involved two separate experiments, both of which had this basic instructional comparison as their major

purpose. Experiment I was conducted during the summer of 1965, but the unexpected outcome of the results and questions raised thereby led to the second, more extensive study. Experiment II served (1) to replicate the findings of the first experiment in a different laboratory with a slightly different procedure, and (2) to investigate the extent to which the instructional effect was dependent upon the essential feature of the classical conditioning paradigm, namely, the pairing of the CS with the US.

EXPERIMENT I

The purpose of this experiment was to determine the effect of facilitatory and inhibitory instructions upon the magnitude (volume) of conditioned salivary responses. Except for instructions, all subjects were treated identically in a standard conditioning design.

Method

Subjects. Two groups of 26 subjects each comprised the two instructional groups, hereafter referred to as F (Facilitatory) and I (Inhibitory) groups. All subjects were high school students who were solicited by a local newspaper ad and who were paid for their services. The data of 3 females and 1 male in the F group could not be used because of unsatisfactory electromyograms (EMGs), resulting in 22 subjects in this group. There were 13 males and 9 females in the F group, and 14 males and 12 females in the I group.

Apparatus. The sialometer and other apparatus employed to collect, measure, and record the saliva have been described

in more detail elsewhere (Feather and Wells, 1966). The basic features of this system involved the collection of saliva by a small parotid collecting capsule of stainless steel with two concentric chambers which was placed in the left cheek over Stensen's duct, the outlet to the left parotid gland. The outer chamber was connected to a source of vacuum and held the capsule in place. The inner chamber rested directly over Stensen's duct and was connected by means of semi-rigid polyethylene tubing to a flask containing carbon tetrachloride. Sufficient vacuum was applied to this flask to provide about atmospheric pressure at the salivary duct. Saliva at the exit of the duct displaced an equal volume of carbon tetrachloride through a dropper needle. Drops of 1/480th cc volume interrupted a light beam aimed at a photoelectric cell. The interruption of the light beam by the drops provided a pulse which was amplified and recorded by a Grass Model 7 polygraph. In addition, these electrical impulses corresponding to drops were used to operate electromechanical counters. Automatic timing and programming equipment totalled the counts of drops during and following the CS-US interval.

The CS was a 1000-cps tone at approximately 60 db (re. .0002 dyne/cm^2) interrupted once per second and administered by an Eico code practice oscillator through a Monarch stereo headset worn by the subject. The US was 3 cc of 0.5% citric acid flavored with artificial sweetner ("weak lemonade") administered over a 3½-sec period to the left lateral margin of the tongue via polyethylene tubing attached to the outside of the parotid capsule. The quantity and duration of the US were controlled

by the use of solenoid valves and electronic timers. EMGs were taken to detect any swallowing, tongue movements, or motor activity of the mouth which might affect salivation and hence render the trial unusable. Two EMG electrodes were placed one centimeter on either side of the midline of the submental region and a reference electrode was placed on the left earlobe. Further control over motor activity was achieved by instructing subjects to swallow only when a sign in front of them reading, "You may swallow now," was lighted. This sign was lighted immediately following the simultaneous offset of the CS and US and remained on for 30 sec. The subjects were isolated from the experimenter and the recording apparatus in a separate, sound-attenuated chamber.

Design. Subjects in both F and I groups received 10 conditioning trials in the test session. A conditioning trial consisted of a 13½-sec CS (interrupted tone) overlapped during the last 3½ sec by the administration of the 3 cc of acid, thus providing an interstimulus interval of 10 sec. These trials were administered by automatic timing and programming equipment at an intertrial interval directly dependent upon the subject's ongoing salivary rate.

No trials were given for 90 sec following the preceding trial, this 90-sec period thus comprising the measurement period for the unconditioned response (UR). After that minimum period, a new trial was initiated automatically on the first occasion when the time between two drops of saliva was at least 5 seconds. Thus, all conditioning trials occurred at comparable

prestimulus salivary rates, while the intertrial interval varied from trial to trial and from subject to subject.

To establish an expected value of the subject's baseline level of salivation against which CR periods could be compared, similar periods in which salivation was measured were interspersed following every second trial. During these 10-sec periods, the subject received no stimulation, but unknown to him his salivary rate was measured automatically and recorded both on the polygraph record and on the electromechanical counters. These 5 "dummy" trials were given by the same criteria as were the 10 conditioning trials.

For half of the subjects the dummy trials were given following the even-number experimental trials and for the other half of the subjects the dummy trials followed the odd-numbered experimental trials. This was an attempt to equalize any possible effect resulting from the longer intertrial intervals which introduction of the dummy trials produced.

Procedure. The subjects came for two sessions, one interview session and a one-hour experimental session. The interview session involved an assistant's showing the subject the experimental room and apparatus and explaining the purpose of the experiment. All subjects were asked to omit the last meal prior to the experimental session.

At the beginning of the experimental session, the subject was seated in a comfortable reclining chair in the sound-attenuated experimental chamber, and the capsule, EMG electrodes, and earphones were attached. The experimenter then

delivered 3 cc of the "weak lemonade" (US) to ascertain the placement of the capsule. If the capsule and electrode placement were satisfactory, the door was closed and the subject received the prerecorded instructions through the earphone.

Instructions. Subjects in the F group heard the following instructions read twice:

> At certain times you will hear a tone. During these times we ask you to try to increase your mouth watering. While the tone is on, make a mental effort to increase your mouth watering. Do not make any sucking or swallowing movements nor movements with your mouth or tongue. Try to increase your mouth watering by merely concentrating or thinking of things that you think would increase your mouth watering. For every time that you have been successful you will receive an extra nickel.
>
> A few seconds after the tone comes on, you will receive some weak lemonade. You may swallow then. The sign in front of you will light up at that time telling you that you may swallow. Please do not swallow, suck, or move your mouth or tongue unless the sign is lighted . . . .

The I subjects were given identical instructions except that they were asked to attempt to decrease rather than to increase their rate of salivation.

After hearing the instructions, subjects in both groups were given a second US as an additional check on correct capsule placement and in order to elicit a preconditioning measure of salivation. And after the completion of the 10 experimental trials, one final US was given.

Results and Discussion

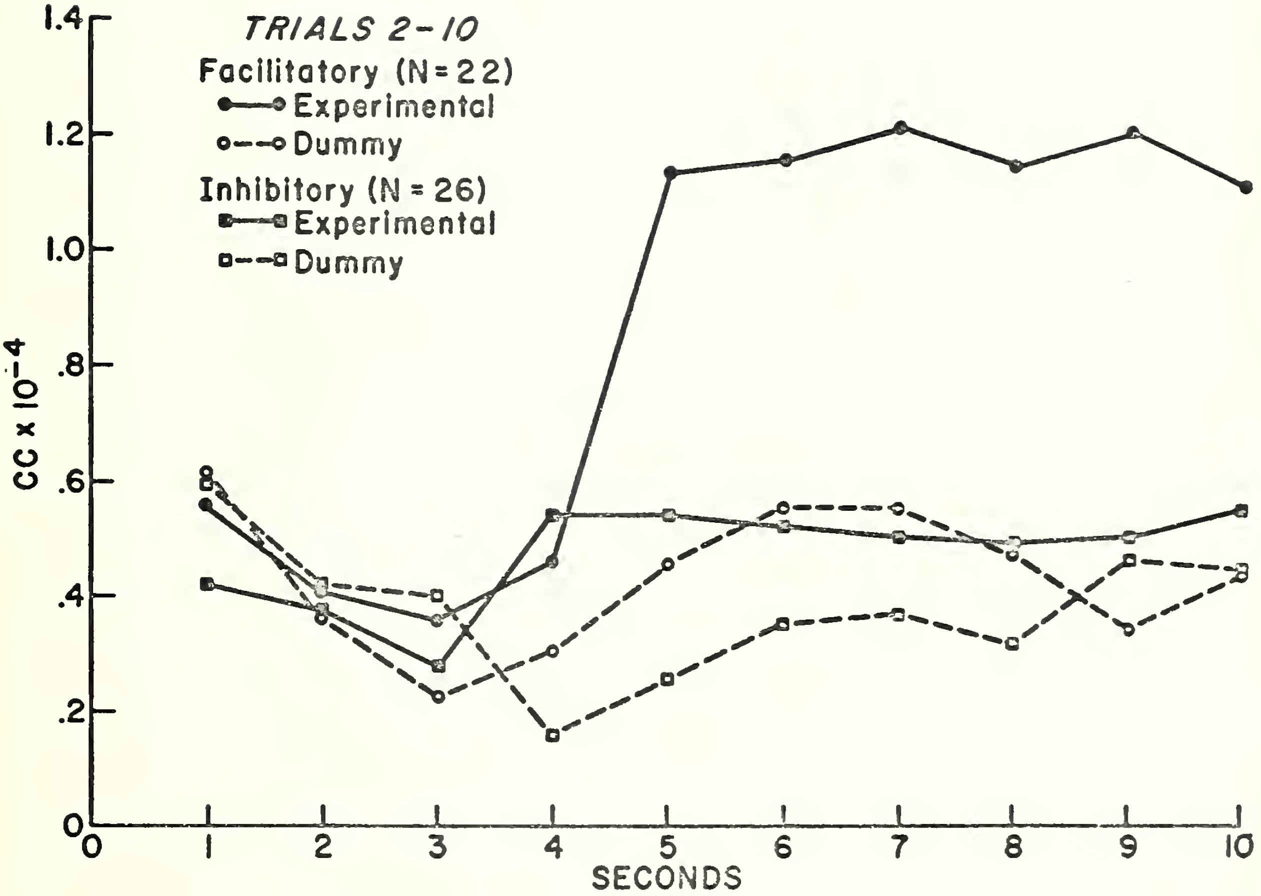
All data presented in this section were derived from

the electromechanical counter displays and were cross-checked for accuracy against the polygraph recordings.

Definition of the dependent variable. Briefly, the measure of salivary conditioning employed was the difference between the average number of drops given in response to the CS and the average number of drops given in comparable dummy periods. This measure was calculated for each subject as follows: (1) The average number of drops for all 10 sec following the CS onset was calculated for all usable experimental trials. Only those trials were used which the simultaneous EMGs indicated were not accompanied by any appreciable motor movements according to pre-established criteria (e.g., EMG activity must not exceed 1/5th of the highest EMG amplitude recorded during UR periods). Data for the first experimental trials were excluded also; these responses could not be indicative of conditioning since they had not been preceded by any CS-US pairing. (2) The average number of drops for all 10 sec of the usable dummy trials was calculated. (3) The difference between these two averages was obtained. This difference score is considered to be a measure of conditioning which is relatively independent of the subject's baseline level of salivation. The average experimental and dummy trial response, the difference score, and the total drop data for all subjects are listed in Appendix A.

The analysis of primary interest was the effect upon conditioning of the different instructions. Before examining the results statistically, it may be instructive to view the results presented graphically. Figure 1 is a composite graph

Fig. 1. Salivary Rate of Facilitatory and Inhibitory Conditioning Groups During Comparable Experimental and Dummy Trials.


TRIALS 2-10
Facilitatory (N=22)
Experimental
Dummy
Inhibitory (N = 26)
Experimental
Dummy
CC x 10⁻⁴
1.4
1.2
1.0
.8
.6
.4
.2
0
0
1
2
3
4
5
6
7
8
9
10
SECONDS

showing comparable experimental and dummy trials for the F and the I instructional groups during the CS-US interval. The initial peak volume in the first second is considered to be spurious for the following reasons. The prestimulus rate of deceleration of salivation when the trial is initiated usually is less than one drop per second. A 5-sec interval since the preceding drop initiates the trial automatically as described earlier, but there is then a high probability that the next drop will be "caught" within the first second of the measuring period. After this, it is probable that more than another second will pass before the next drop, and so on, until the effect of the CS intervenes on the gradually decreasing rate. The dummy-trial curve suggests a gradually fluctuating rate which is characteristic of the unstimulated baseline rate of salivation. Inspection of Figure 1 reveals a sharp increase in the salivary rate of the F subjects in the fourth second following CS onset. Responding reaches a near-maximal point by the fifth second, and no appreciable decline is noticeable during the remainder of the interstimulus interval. By contrast, the I subjects show only a small increment of responding to the CS as compared to responding during their dummy trials.

Students' t tests (two-tailed) of the significance of the difference between experimental and dummy trials were calculated for both F and I groups. For the F group the difference was significant ($p < .005$) with a t of 3.24 and 21 degrees of freedom, whereas for the I group the difference was not significant ($p < .2$) with a t of 1.36 and 25 degrees of freedom.

The subjects who received facilitatory instructions clearly demonstrated salivary conditioning, whereas those who received inhibitory instructions did not show conditioning to any appreciable degree.

The conditioning measures from the two instructional groups were significantly different from each other ($p < .05$) in the direction indicated, with a _t_ of 2.33 and 31 degrees of freedom. In this case, the lack of homogeneity between the two population variances ($F < .01$) makes advisable the use of the approximate method (Li, 1957) for obtaining _t_ values, and consequently the degrees of freedom are reduced from 46 to 31. Even so, the probability of the outcome still suggests that instructions significantly affected CR magnitude, but because this was a new and unexpected finding for salivary conditioning at the time, the second experiment was planned as a replication of this effect.

Following the discovery of the instructional effect, the first-trial data were examined to see if the facilitatory or inhibitory instructions had an effect on salivary response at a time before any actual CS-US pairing had occurred. Contrasted with their closest dummy trials, the F difference scores were found to be significantly greater than the I difference scores ($p < .01$) with a _t_ of 2.88 and 34 degrees of freedom. This unexpected difference suggested the need for a more systematic investigation of the extent to which subjects could influence their salivary rate to a signal which was never paired with the US, and the second experiment was designed to include

a comparison of this type.

Studying the effect of instructions upon nonpaired trials was also an initial test of the widespread belief that the ongoing salivary secretion can be brought under voluntary control by thinking of appropriate foods. The literature does not provide any experimental support for this notion (Winsor, 1930; Kerr, 1961), but it is possible that the earlier investigations were confounded with technical problems such as were the early efforts to obtain salivary conditioning in humans. In any case, a study of the role of voluntary factors on the ongoing or unconditioned salivary response seemed justified using the same collecting and measurement techniques which had overcome some of the problems which previously had plagued salivary conditioning research.

As a beginning inquiry into the possible mechanisms or correlates of the instructional effect, some attention was given to how subjects thought they had influenced their salivation. Typical written statements from among the more successful facilitatory subjects are as follows:

> Imagining I was eating very bitter foods like pickles and salads . . . using dressing in large amounts . . . .
>
> When the tone came on, I thought about a big steak . . . at other times, that I could make much water come into my mouth . . . at other times, I thought of women.
>
> I concentrated on the sour lemonade that followed the tone . . . and sometimes found my mouth watering during the tone.

Typical statements from the more successful I subjects are as follows:

> I thought that every time the signal pulsated that my saliva gland produced in the opposite direction. In other words, pushed the saliva backwards.
>
> I tried to relax . . . and [thought] about being somewhere where it was very dry and I needed water . . . I also reminded myself of how I got after running in a race, or dancing for a long time . . . .
>
> At first, I thought to myself, "My mouth is not going to water" . . . and then, "My mouth is going to stay dry" . . . .

Although the content of these statements is obviously different for the different instructional groups, there was no suggestion of a relationship between the statements and the performance within either group. The least successful facilitators and inhibitors gave statements that were indistinguishable in content from those who were most successful within their respective groups.

EXPERIMENT II

This experiment repeated the main question of the previous study, namely, is there a differential effect upon conditioning from asking some subjects to increase their salivary response to the CS and asking others to decrease their response? A second question, dependent upon the outcome of the first question, was whether the instructional effect is independent of the tone being followed immediately each time by the unconditioned stimulus. To answer these two main questions, four groups of subjects were employed: a paired facilitatory (PF), a paired inhibitory (PI), a nonpaired facilitatory (NF), and a nonpaired inhibitory (NI) group.

Previous conditioning studies (Feather, 1967) have indicated that salivary conditioning occurs early and does not increase with further trials, so that it seemed advisable to limit the present comparison to a one-session design. Furthermore, the duration of effect of the unconditioned stimulus upon baseline salivation is long enough to limit the number of trials which can be given during a one-hour testing session. These restrictions precluded a within-subject design and led to the plan of administering 10 trials to four separate groups of sub-

jects in a 2 x 2 factorial comparison of the effect of two types of instructions and the effect of two types of stimulus ordering.

As in the previous experiment, the instructions informed the subjects whether or not the signalling tone (CS) would be followed immediately by the US or whether it never would follow directly after the tone. This was an attempt to reduce differences in expectancies which might arise otherwise.

Following the conditioning trials, and before leaving the experimental chamber, a post-experimental questionnaire entitled "Subject's Reaction to Experiment" was given to each subject. This was to serve (1) as a check on how well the instructions were accepted, and (2) as an initial appraisal of other, more general, attitudinal factors which might relate to performance in the conditioning situation. This questionnaire was adapted from one initially devised by Kimble and Fowler (Fowler, 1964; Kimble, 1967), a revision of which was in use in attitudinal studies of eyelid conditioning. The subject made a series of judgments by encircling one of the 11 values which represent the 11 decile steps from 0 to 100. Upon completion of the questionnaire, subjects were asked to recall how they had influenced their salivation, as in the earlier experiment.

Method

Subjects. All the subjects were either Duke University

undergraduate students or high school students. The Duke students (N = 68) were taking their first course in psychology and volunteered in order to fulfill a part of the laboratory requirement for that course. The high school students (N = 33) were recruited and paid for their services during the summer of 1966 when college students were unavailable. None of the subjects had been in a salivary conditioning experiment before.

One hundred and one subjects were tested; 53 males and 48 females. Of these, the data of 29 subjects were unusable; 20 because of apparatus and procedural difficulties, 6 because of excessive motor activity during trials, and 3 because the baseline level of salivation did not decrease to the necessary level for sufficient trials to be administered.

The remaining 72 subjects (41 males and 31 females) were assigned to the four experimental groups with one exception. The first 5 subjects were run in the PF group to insure the occurrence of conditioning with the new apparatus and the new procedure. Following this, subjects were assigned to one of the four groups until a total of 18 was obtained within each group; these included 54 college students and 18 high school students. Finally, the results of one NI subject were omitted from all graphical presentations and statistical analyses because statistical test (Dixon and Massey, 1957, pp. 275-8) indicated this extreme observation could be treated as an outlier, $p < .01$.

Apparatus. The apparatus employed to collect, measure, and record saliva was almost identical to the one employed in the previous study. The location of the apparatus in the exper-

imental chamber made it advisable in this second experiment to place the parotid collecting capsule over the outlet of the right, rather than the left, parotid gland.

The CS was a 1000-cps buzzer tone at approximately 60 db interrupted once per second and administered from a Hewlett Packard audio oscillator Model 200 ABR through a Monarch stereo headset worn by the subjects.

A major change in the second experiment involved the use of acetic acid rather than citric acid as the US, because comparable hydrogen-ion concentrations of acetic acid had been found (Chauncey and Shannon, 1959; Feather, Delse, and Bryson, 1967) to produce higher levels of unconditioned salivation. Consequently, the US consisted of 3 cc of 0.3% acetic acid which was administered over a 2-sec period to the right lateral margin of the tongue, as described previously.

Motor activity was monitored by submental EMG electrodes as in the first experiment, except that the electrodes were now grounded on the right earlobe. A sign lighted up saying, "You may swallow," immediately following the CS and US offset and remained on for 30 sec.

Recording by a Grass polygraph and counting by an electromagnetic counter were carried out as before, and in addition a second-by-second automatic print-out of all drop information during CS, dummy, and UR periods was obtained.

The subjects were isolated from the experimenter and from the recording apparatus in a separate sound-attenuated chamber but could be observed by the experimenter through a one-

way mirror.

Design. Each subject in the two paired groups received 10 conditioning trials and 5 dummy trials during the test session. A conditioning trial consisted of a 12-sec CS (interrupted tone) overlapped during the last 2 sec by the administration of 3 cc of 0.3% acetic acid, thus providing an interstimulus interval of 10 sec. The dummy trials were 10-sec periods, which were interspersed following every second conditioning trial, in which the subject's salivary rate was sampled and recorded as a basis for comparison with the experimental trials. All of the trials were administered automatically by appropriate timing and programming equipment at an intertrial interval directly dependent upon the subject's ongoing salivary rate.

No trials were given during the 45 sec following the preceding experimental trial, this 45-sec period comprising the UR-recording period. After that minimum period, a new trial was initiated automatically on the first occasion in which the time between two drops of saliva was at least 3 sec.

The two nonpaired groups received ten 10-sec CSs and ten 2-sec USs identical to that of the paired groups, but these stimuli were never paired and were always separated by a minimum period of 45 sec. The presentation of these CSs and the five comparable dummy trials was accomplished in the same way as for the paired groups, except that all the subjects in the two nonpaired groups received dummy trials following the odd-numbered trials. This latter was done to simplify the testing procedure, since no effect due to the different dummy trial

locations had been detected in earlier experiments.

Procedure. Subjects came for two sessions as in the previous experiment. Both the interview and the one-hour testing were conducted by the experimenter. Special attention was given to handling of the subjects before the actual testing because it was felt that the effectiveness of the instructions might be especially dependent upon subject cooperation. In the previous experiment, subjects had been paid volunteers from a high school population who were generally very cooperative, but in the present study the majority (75%) of the subjects were nonpaid, essentially nonvolunteer, college students who often were suspicious about being tricked. During the initial interview, therefore, the purpose and design of the experiment was explained in more detail than previously, and the subjects were told that they could discuss the experiment with others if they wished. They were told that they would be asked to try to influence their salivary rate, and suggestions were given as to how this could be accomplished (e.g., thinking of sour foods for increasing, or of frightening experiences for decreasing).

Subjects were not asked to omit their last meal before the test session, contrary to the custom of the earlier experiment, in order to reduce the likelihood that physical discomfort might prevent compliance with the instructional task.

During the test session the subject was seated in a comfortable reclining chair in the sound-attenuated chamber, and the capsule, EMG electrodes, and earphones were attached. The experimenter told the subject that he would first receive

some weak vinegar solution to ascertain correct capsule placement, and then would hear the prerecorded instructions which would tell him to which group he had been assigned.

Instructions. Subjects in the PF group heard the following instructions read twice:

> In this experiment we are interested in finding out whether people can influence their own salivary rate.
>
> At certain times you will hear a tone, like this. . . . During these times we ask you to try to increase your rate of salivation. While the tone is on, make a mental effort to increase your rate of salivation. Try to increase your salivary rate by merely concentrating or thinking of things that you think would increase your salivation. We will tell you at the end of the experiment how many times you were successful at increasing your rate of salivation when the tone came on.
>
> Several seconds after the tone comes on, you will receive some weak vinegar. You may swallow then. The sign in front of you will light up at that time, telling you that you may swallow. Please try not to swallow, suck or move your mouth or tongue unless this sign is lighted. . . .

The PI group heard identical instructions except that they were asked to decrease rather than to increase their salivation.

The NF and NI groups heard the first two paragraphs of the above instructions asking them to increase or decrease their salivation, respectively, and then heard the following:

> From time to time you will receive some weak vinegar solution. This will never follow directly after the tone . . . .

After hearing the instructions, subjects in both groups were given a second US as an additional check on correct capsule placement and in order to elicit a preconditioning measure of salivation. And after the completion of the experimental trials, one final US was given as a postconditioning measure.

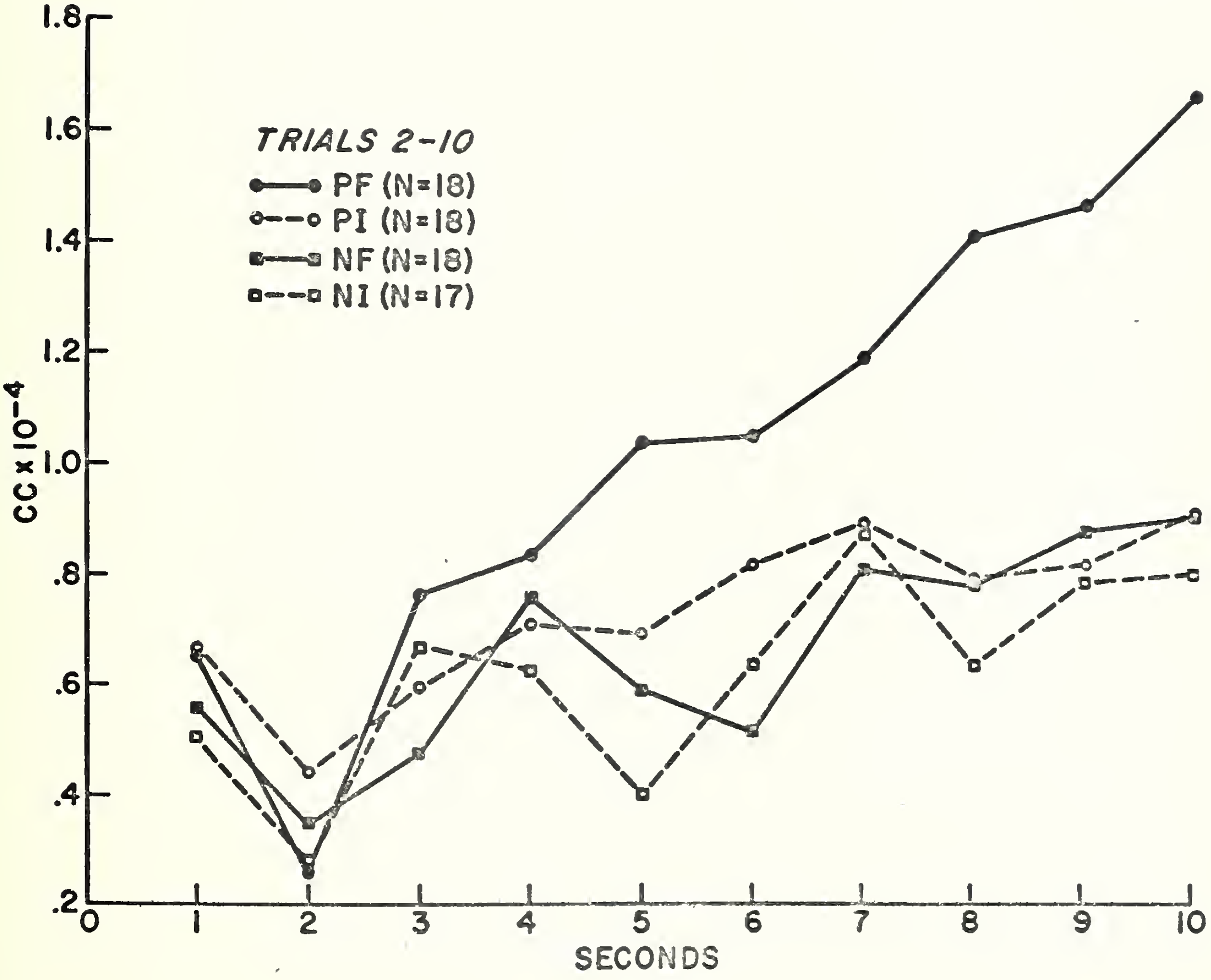
Before leaving the experimental room or being informed of his success, the subject was asked to complete the questionnaire (Appendix B) on his general reaction to the experiment.

Results

All the data reported in this section were obtained from the record sheets which were printed out automatically to correspond to the drops recorded on the polygraph. The printed record of the drops occurring in the 10 sec following CS onset were cross-checked for accuracy with the polygraph record in all instances. The criterion for definition of the dependent variable is the same as that for Experiment I, namely, the difference between the average response on the usable experimental trials and the average response on the usable dummy trials.

The main comparison of interest is the difference among the four groups. Figure 2 presents the second-by-second response during the CS onset for the four groups. Inspection clearly indicates that the PF group shows the greatest response increment during the CS-US interval. This response begins to increase during the third second and climbs steadily until the tenth second, whereupon the US onset obscures any further CR measurement. None of the other three groups appears to differ appreciably from any other. As mentioned in the previous experiment, the initial peak volume in the first second in all the curves is a spurious effect due to the method of trial

Fig. 2. Salivary Rate of Paired Facilitatory, Paired Inhibitory, Nonpaired Facilitatory and Nonpaired Inhibitory Groups During Comparable Experimental Trials.


TRIALS 2-10
PF (N=18)
PI (N=18)
NF (N=18)
NI (N=17)
CC x 10⁻⁴
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1
2
3
4
5
6
7
8
9
10
SECONDS

initiation and the decelerating salivary rate in progress at the time.

Figure 3 presents the experimental and dummy trial response of the PF and PI groups during the CS-US interval. The separation of the PF response from the comparable dummy trial begins during the third second and increases during all but one subsequent second of the interval, whereas the PI response remains beneath that of its comparable dummy trial at all times after the first second of the CS-US interval. More inhibition is suggested here than in the earlier experiment (Figure 1, p. 16).

Inspection of Figure 4 suggests that the nonpaired groups do not differ appreciably from each other nor from their respective dummy trials.

A three-factor mixed model analysis of variance (Table 1) was computed with repeated measures on one of three factors (Winer, 1962). The between-groups comparison represents differences in the level of performance due to instructions and stimulus order, while the within-subjects comparison represents differences in the pattern of acquisition.

The instructions factor is highly significant ($p < .001$), which confirms the finding of Experiment I. When this main effect is examined further by means of a simple-effects analysis (Table 2), the overall instructional effect is found to be largely attributable to the differences between the two groups, PF and PI, that received the regular conditioning trials ($p < .001$). Separate $\underline{t}$ tests indicated significant evidence of

Fig. 3. Salivary Rate of Paired Facilitatory and Paired Inhibitory Groups During Comparable Experimental and Dummy Trials.

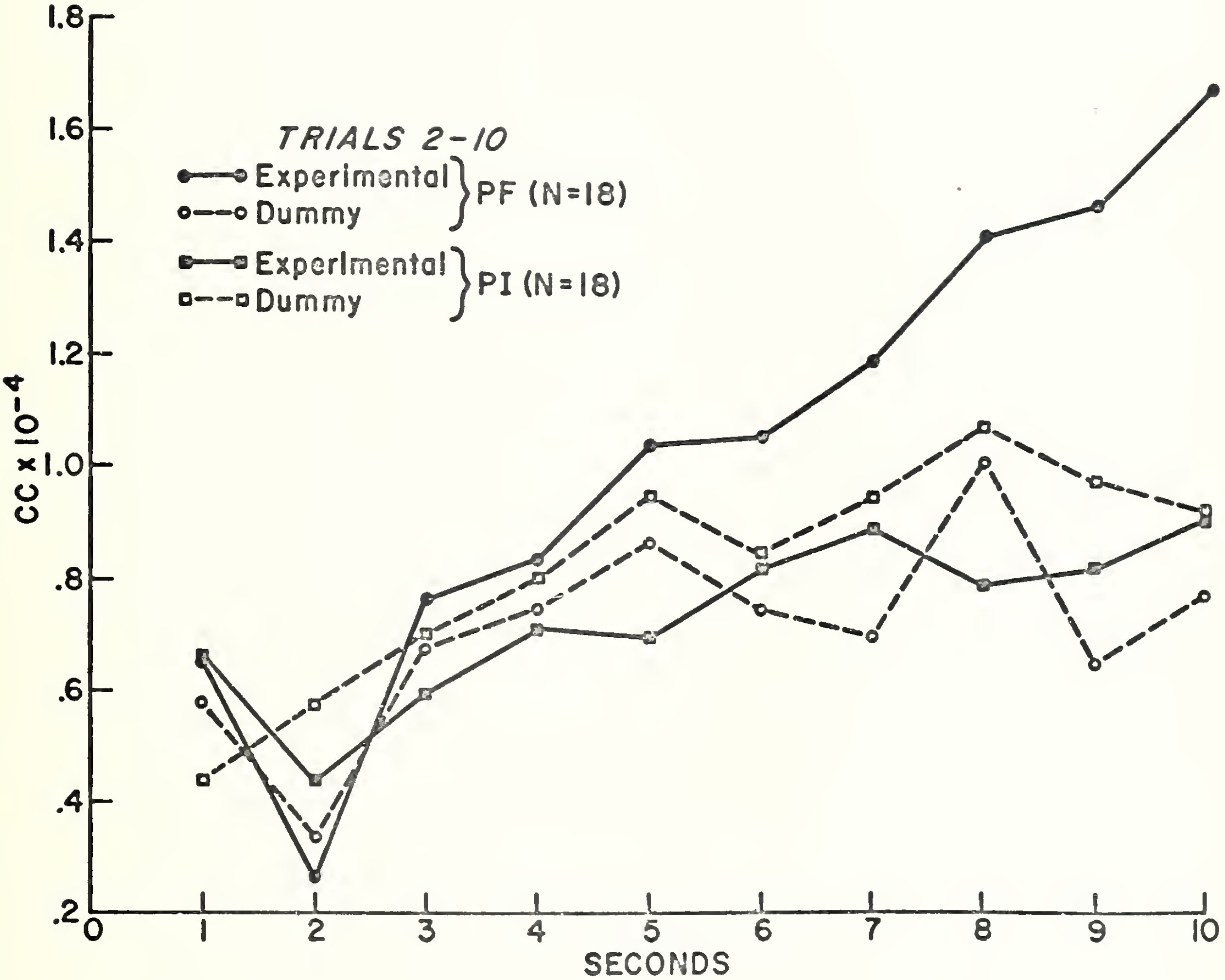

TRIALS 2-10
Experimental
Dummy
PF (N=18)
Experimental
Dummy
PI (N=18)
CC x 10⁻⁴
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1
2
3
4
5
6
7
8
9
10
SECONDS

Fig. 4. Salivary Rate of Nonpaired Facilitatory and Nonpaired Inhibitory Groups During Comparable Experimental and Dummy Trials.

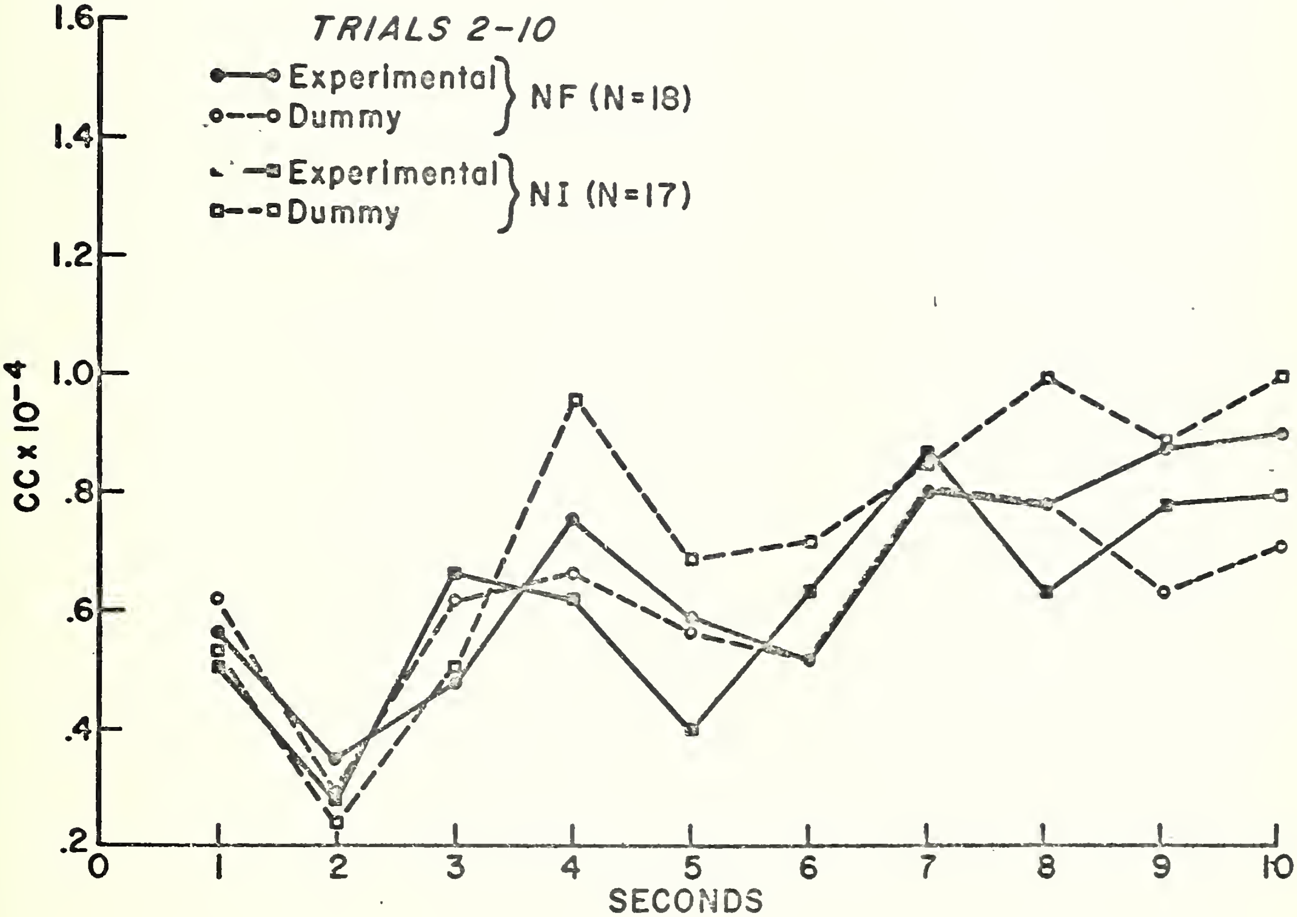

TRIALS 2-10
Experimental
Dummy
NF (N=18)
Experimental
Dummy
NI (N=17)
CC x 10^-4
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1
2
3
4
5
6
7
8
9
10
SECONDS

Table 1. Analysis of Variance

Source	df	SS	MS	F
Between subjects	71	791.2	11.1	
Instructions (A)	1	114.3	114.3	12.71**
Stimulus order (B)	1	44.5	44.5	4.95*
AB	1	20.9	20.9	2.32
Subjects within groups (error-between-)	68	611.5	9.0	
Within subjects	232	1,846.0	8.0	
Trials (C)	4	8.3	2.1	0.26
AC	4	33.7	8.4	1.05
BC	4	49.5	12.4	1.55
ABC	4	26.1	6.5	0.82
C X subjects within groups (error-within-)	216	1,728.4	8.0	

*$p < .05$
**$p < .01$

Table 2. Simple Effects of A (Instructions) for Levels B_1 (Paired) and B_2 (Nonpaired)

Source	df	MS	F
A for B_1	1	116.5	12.95**
A for B_2	1	18.7	2.08
Error	68	8.99	

**$p < .01$

conditioning in the PF group ($p < .02$, two-tailed) but no evidence of any conditioning in the PI group. Table 2 indicates that facilitatory and inhibitory instructions were relatively ineffective ($p < .25$) in the absence of stimulus pairing although the direction of the effect was the same as for the paired groups. The absence of an appreciable interaction further reflects this tendency for there to be some instructional effect on both the paired and the nonpaired groups.

Perhaps the most important new information obtained from this second experiment, however, is that the instructional factor is considerably more significant ($p < .001$) than the stimulus-order factor ($p < .05$). Stimulus-order differences contributed less than half as much variance on the average as did the instructions. Further breakdown of the stimulus-order factor (Table 3) indicates that whether the stimuli are paired is important for the two facilitatory groups, PF and NF ($p < .02$). The absence of any difference between the PI and NI

Table 3. Simple Effects of B (Stimulus Order) for Levels A_1 (Facilitatory) and A_2 (Inhibitory)

Source	df	MS	F
B for A_1	1	63.2	7.03*
B for A_2	1	2.2	0.25
Error	68	8.99	

$*p < .05$

groups, on the other hand, suggests that pairing of the stimuli is entirely ineffective when subjects have received instructions to inhibit their salivation.

The questionnaires were examined to determine how the instructional task was accepted and to detect suggestions of other, more general, attitudinal states which might relate to conditioning success and task compliance. The average group response for each of the 12 questionnaire items is listed in Table 6, Appendix D. (Data for one PF subject and for two PI subjects are omitted because they responded only on the extreme ends of the 11-point scale, contrary to instructions.) Inspection of the data suggests a tendency for PF subjects to evaluate the experiment in more positive terms than the other three groups. The PF subjects report the most willingness to serve again, the highest estimate of how much the experiment revealed, the greatest interest, the most approval, the least suspicion, and the least anger over the procedure. On the other hand, PF

subjects report more anxiety in the experiment, that the US was more unpleasant, and that the CS gave them a sensation of sourness more than did the other groups.

Within-group analyses were made with the Mann-Whitney U test to determine possible relationships between salivary response and subjects' general attitudes toward the experiment. Table 7, Appendix D, lists the $\underline{z}$ scores which represent differences in the questionnaire responses of the high and low salivary responders, when the latter are defined by a median-split of the CR difference scores within each group. These results are to be interpreted with caution because the items are not independent of each other, and a large number of tests were made with relatively few subjects. However, the analysis suggests that the better conditioners within the PF group reported more sensation of sourness to the CS, more anxiety in the test situation, more unpleasantness associated with the US, and more passivity in the situation than did the poor conditioners.

The most significant finding in Table 7 is that high responders in the NI group report more suspicion about being tricked than do low responders, or, stated in another way, the best inhibitors in the NI group were those who were least suspicious of being tricked. Subjects who believed the instructions that the CS would never be followed by the US directly presumably were better able to inhibit their salivary response to the CS, and hence to comply with the instructions for their group.

DISCUSSION

The significant difference between the paired facilitatory and inhibitory groups in Experiment II confirmed the findings of Experiment I that instructions to increase or decrease salivary response to a CS are effective. This extends the finding to a different subject population, a more effective US, a different experimental laboratory, and a slightly different experimental procedure.

Clearly, the most important result of the second experiment is that the instructional effect was so much more significant than the effect of stimulus order upon salivary response. Here is a case of a nonassociative factor having a more determining effect than an associative factor upon the acquisition of a conditioned autonomic response. And this has little precedence in the classical conditioning experiment, albeit such comparisons rarely have been made. The most comparable studies have involved instructions which manipulate emotional or drive states (e.g., telling the subject he will or will not receive a shock), which in some cases has proved more effective than conventional stimulus variables, such as number of reinforcements or US intensity (Cook and Harris, 1937; Grings and Lockhart,

1963; Bridger and Mandel, 1965). It is not at all clear that instructions in the present experiment had their effect by such differential arousal or suppression of central drive states. The differences in reaction to the experiment between PF and PI subjects (Appendix D, Table 6) do not appear large enough to support such an explanation. Closure on this issue must await more careful control and evaluation of the relevant subject-centered variables than the present questionnaire data allow.

Further evaluation of the instructional effect is possible with respect to the relative contribution of the two types of instructions. To decide which type of instruction was more effective, a control group free of either facilitatory or inhibitory set would be desirable but probably unattainable, since the subject undoubtedly develops his own set toward the task in the absence of instructional sets. By limiting our concern to instruction-produced sets, a general answer to this question may be obtained by comparing the performance of the PF and PI subjects with the performance of subjects in an earlier experiment (Feather, Delse, and Bryson, 1967) who did not receive any instructions on how to respond, but who otherwise received the same experimental treatment. To the extent that such comparisons are meaningful, it would appear that facilitatory instructions contributed little to salivary conditioning in the present experiment, and that the observed instructional effect was the result of inhibitory instructions alone. In the earlier experiment an average difference score of 1.53 drops

was obtained from 14 high school students in seven trials, which compares with the finding in the present experiment of (1) an average PF difference score of 1.48 drops, and (2) an average PI difference score of 0.07 drops in nine trials. The CR magnitude of subjects who received facilitatory instructions is obviously quite similar to that of the subjects who received no such instructions, while the response of the inhibitory group is clearly much less.

That the instructional effect may be largely attributable to an induced inhibitory set acting against a conditioning tendency is similar to the situation in eyelid conditioning. In both cases it appears to be the inhibitory instructions which have the greatest effect. It should be noted, however, that while inhibitory instructions prevent acquisition of salivary responses, they do not have such a strong effect upon eyelid conditioning.

Since the facilitatory instructions seem not to have a facilitatory effect upon salivary response in the paired CS-US situation, it is not surprising that they do not have an effect on response in the nonpaired CS and US situation. This fails to confirm the suggestion raised by the first-trial difference noted in Experiment I and leaves the earlier finding essentially without explanation. The first-trial effect was not replicated in the comparable groups of Experiment II, however, so it would appear useless to pursue that matter further. But, perhaps more attention should be given to the failure to find a statistically significant effect on the basal response of the

nonpaired groups in view of the widespread belief that such control is possible. Well-known sources promote the viewpoint which the present findings have failed to support. For instance, Woodworth and Schlosberg (1954, p. 574) note, "If you wish to stimulate the flow of saliva, you have but to think of a nice, juicy steak." The question might be raised as to whether the present experimental design tested the notion of voluntary influence either adequately or fully. For instance, was the signalling time of 10 seconds or the number of trials in the session too limited for the necessary voluntary effort to be made or detected effectively? Recent work in the same laboratory has not indicated any greater effectiveness of subject control from extending the signalling period to 30 seconds, although again a slight difference in the predicted direction has been detected. The failure of an acquisition effect in the present experiment argues against the position that more trials might have revealed a larger effect.

Although the present study has been concerned with classical or Pavlovian conditioning methods, the results do suggest that some instrumental control of the conditioned response might be possible, at least with reference to response inhibition. A recent study (Miller and Carmona, 1967) indicates that salivary response in thirsty dogs can be instrumentally conditioned or inhibited by rewarding spontaneous increases or decreases of salivation with water rewards. Possible mediation by breathing or other skeletal response was not ruled out completely in this study because of technical limitations, but no

overt indication of such involvement was observed. On the basis of their results, Miller and Carmona suggest that salivation might be a part of a larger pattern of general arousal or relaxation. In particular, they observed that dogs rewarded for increasing salivation were more alert and displayed fast, low-voltage EEG activity, while those rewarded for inhibiting salivation tended to be more drowsy and had more slow-wave, high voltage EEG activity.

The questionnaire data give tentative support to the notion that increased salivary conditioning might be a correlate of an aroused state. The best conditioners within the PF group reported significantly more anxiety and more discomfort from the US than did the least successful conditioners. However, the history of salivary research with humans is replete with contradictions concerning this general, poorly defined topic of arousal, so that suggestions derived from the questionnaire data will be valuable only if they lead to further, more systematic investigation of the relationship between the subject's general attitude toward the experiment and his conditioning performance.

Further data were gathered to provide an estimate of the relationship between the subject's success in the instructional tasks and his own report of how he tried to influence his salivary rate. Some samples are given to suggest that subjective impressions do not appear related to performance _within_ either the PF or the PI group.

Statements from the five most successful subjects in

the PF group are as follows:

> I thought of foods such as lemons and grapefruit. I also thought of a very good-looking boy.
>
> Imagined sour foods, salt.
>
> I imagined the taste of the vinegar itself.
>
> Thought often of a good steak . . . thought of very pleasant situations, which may or may not have involved food.
>
> First of all, I anticipated the future reaction to the unpleasant sourness. I could also feel my glands swell after I had been somewhat conditioned to the sequence of expected events. I concentrated on this feeling and put my full attention on that part of my body . . . .

These are hardly distinguishable in content from the statements of five of the least successful subjects in the PF group:

> Thought about eating a lemon, strawberries, or unripe plums. Also thought of the approaching vinegar . . . .
>
> Occasionally I thought of the vinegar that was going to come . . . other times about smoking my pipe because my salivary rate usually increases when I smoke it . . . .
>
> I focused my mind on an individual giving a lemon or lime to a baby . . . .
>
> I tried to imagine some of my favorite foods like a rare barbecued steak, lasagne, ...
>
> I tried to think about kissing my girl friend.

Statements from the four most successful inhibitors from the PI group are as follows:

> At first I tried to think of an exhausting act, i.e., a cross-country race. Then I just concentrated on not salivating.
>
> Thought of bad tasting foods, thought of good foods until the tone and then stopped thinking . . . tried worrying about hypothetical big test I hadn't studied for or impending competition in some athletic contest.

> Thought of dead rabbit I saw once . . . thought of death without after-life . . . tried to will salivation to stop on subsequent trials . . . .
>
> I tried to think of hot, dry sand while at the same time concentrating on not salivating.

These are hardly distinguishable from the statements of the four least successful inhibitors from the PI group:

> At first I tried to think of myself in some situation which would cause my mouth to go dry, such as public speaking. After the first few times I just deliberately concentrated on reducing my rate of salivation.
>
> I tried to imagine the accident I had not too long ago. It was a terrible wreck and I got hurt worst of all.
>
> I personally thought about a previous experience in which I was afraid . . . .
>
> I tried concentration first and then [imagined] dust and cotton in my mouth.

In addition to the above lack of correspondence between the verbal report and the appropriate physiological response, there also appeared to be little relationship between the subjects' frequent estimates of their success and their actual performance. One reasonable explanation which has been proposed (Kerr, 1961) for the belief that one can influence his salivary response is as follows:

> In the waking individual the mouth normally contains saliva but there is no awareness of this fact. When an individual thinks about or sees food his attention becomes focused on his mouth, and he becomes conscious that his mouth contains saliva. Not being aware of the presence of saliva in his mouth before his attention became fixed on his mouth, the individual interprets the sensation of mouth watering as arising from the arrival of saliva in the mouth. In fact the sensation arises from the concentration of his attention on his mouth and the actual amount of saliva present is not materially increased. (p. 44)

In summary, there has been little support for the as-

sumption that voluntary control of salivation is possible to a signal when that signal is not paired with reinforcement. On the other hand, the conditioned salivary response has been found to be subject to considerable voluntary control, at least, in the inhibitory direction. Further investigation of the relationship of salivation to more general attitudinal and emotional states of the subjects seems indicated and is perhaps more promising than manipulation of the conventional stimulus variables alone.

APPENDIXES

APPENDIX A

Table 4. Salivary Responses for Individual Subjects in Experiment I

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Facilitatory Group				
MW (m)	13.33	2.40	10.93	4640
TS (m)	20.71	9.80	10.91	5792
RL (m)	11.60	2.40	9.20	2595
RD (m)	7.89	2.40	5.49	3499
PR (m)	9.57	4.60	4.97	3207
RR (m)	6.56	2.20	4.36	2201
TN (m)	5.17	1.40	3.77	1787
JD (m)	4.40	2.00	2.40	3079
PW (f)	3.33	1.60	1.74	1116
JJ (m)	8.00	6.60	1.40	5707
CS (f)	1.40	0.00	1.40	1233
GL (m)	1.56	1.00	0.56	1680
JJ (f)	1.22	0.80	0.42	1053
CC (f)	0.29	0.00	0.29	512
TG (m)	1.00	0.80	0.20	189
AM (m)	1.56	1.40	0.16	2714
GG (f)	0.89	0.80	0.09	897
LH (f)	1.00	1.00	0.00	1041
JW (f)	0.88	1.20	-0.32	608
DG (f)	0.88	1.20	-0.32	819
NE (f)	0.33	0.80	-0.47	1325
MO (m)	0.67	1.25	-0.58	2236

Table 4 (continued)

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Inhibitory Group				
DH (m)	9.89	3.40	6.49	4023
KA (m)	7.44	1.40	6.04	3235
FI (m)	9.13	6.80	2.23	2924
PW (f)	4.50	2.80	1.70	10302
JN (m)	2.63	1.80	0.83	1502
DC (m)	3.44	2.80	0.64	1296
TN (m)	0.56	0.00	0.56	1130
KS (f)	3.20	2.67	0.53	2256
MD (f)	1.67	1.20	0.47	1745
AS (m)	1.44	1.00	0.44	1312
SK (f)	1.22	1.00	0.22	709
GS (f)	0.89	0.80	0.09	1195
DS (f)	1.25	1.20	0.05	942
HM (m)	1.22	1.20	0.02	621
BH (f)	0.00	0.00	0.00	965
BB (m)	0.67	0.75	-0.08	567
AP (m)	1.86	2.00	-0.14	1385
TH (f)	0.78	1.00	-0.22	1412
BJ (f)	3.13	3.40	-0.27	2990
AD (m)	0.22	0.50	-0.28	1172
CM (f)	1.89	2.20	-0.31	1516
MF (f)	1.78	2.20	-0.42	2814
SC (m)	0.44	1.00	-0.56	812
JS (f)	1.00	1.60	-0.60	1220
KJ (m)	1.44	3.00	-1.56	1502
KU (m)	0.67	3.25	-2.58	2090

APPENDIX B

QUESTIONNAIRE

Subject's Reaction to Experiment

On the following pages are some statements which express possible personal reactions to this particular experiment. Please indicate your honest reaction to each of these statements by circling a number from zero to 100. If a statement describes your reaction almost perfectly, circle 100. If it does not describe your reaction at all, or describes the opposite of your reaction, circle zero.

Be sure to use the entire scale and not just the extreme values of zero and 100. It is quite unusual for these values to represent a true opinion. Try to make as careful a quantitative judgment as you can.

TEST OF REACTION TO EXPERIMENT

1. Having been in this experiment, my degree of willingness to serve as a subject again, if asked, would be (Circle 0 if very unwilling; 100 if quite willing. Remember to use intermediate values as required in all items.)

   0 10 20 30 40 50 60 70 80 90 100

   extremely unwilling quite willing

2. From my personal point of view, this experiment had great value. Circle 0 if it had no value at all; 100 if it had great value; intermediate values for reaction in between.

   0 10 20 30 40 50 60 70 80 90 100

   no value great value

3. In this experiment, I found myself resisting an apparent attempt to manipulate my behavior. Circle 0 if you noticed no such attempt *or* did not resist; 100 if you noticed and resisted vigorously.

   0 10 20 30 40 50 60 70 80 90 100

   no resistance great resistance

4. I believe that this experiment revealed little or nothing about me as a person. Circle 0 if you believe it revealed nothing; 100 if you believe the experiment probably revealed a great deal about you.

   0 10 20 30 40 50 60 70 80 90 100

   revealed nothing revealed a great deal

5. My over-all reaction to this experiment and the procedures employed is that it was an anxiety-arousing experience. Circle 0 for no anxiety at all; 100 for extreme worry and anxiety.

   0 10 20 30 40 50 60 70 80 90 100

   no anxiety extreme anxiety

6. Recall a time when you have had a bit of dust blown in your eye and had trouble removing it. If you assign the unpleasantness of this experience a value of 100, how unpleasant would you rate the vinegar solution used in this experiment? Try to give an average rating based on all of the vinegar solution administered. Circle 0 for relatively much less unpleasant; 100 for as unpleasant or more unpleasant.

0 10 20 30 40 50 60 70 80 90 100

much less unpleasant at least as unpleasant

7. One of my chief reactions to this experiment was one of increasing annoyance with certain aspects of the procedure. Circle 0 for no anger or irritation at all; 100 for great anger.

0 10 20 30 40 50 60 70 80 90 100

no anger great anger

8. During the experiment I found that my attitude was one of passive detachment rather than that of an active participant. Circle 0 for complete passivity; 100 for active involvement.

0 10 20 30 40 50 60 70 80 90 100

complete passivity active involvement

9. After hearing the instructions, I still expected to be tricked in some way in this experiment. Circle 0 for complete acceptance of the experimenter's presentation of the procedures; 100 for great suspicion of being tricked in some fashion.

0 10 20 30 40 50 60 70 80 90 100

complete acceptance great suspicion

10. One of my chief reactions throughout this experiment was one of great interest. Circle 0 for extreme boredom; 100 for great interest.

0 10 20 30 40 50 60 70 80 90 100

extreme boredom great interest

11. My most general reaction to the experiment falls as indicated below on a dimension ranging from disapproval to approval. Circle 0 for strong disapproval; 100 for approval.

0 10 20 30 40 50 60 70 80 90 100

strong disapproval high approval

12. When you heard the tone, did you imagine a sensation of sourness?

0 10 20 30 40 50 60 70 80 90 100

not at all very vividly

13. Subjects report many different ways in which they have tried to influence their salivary rate. We would find it very helpful if you would describe how you tried to influence yours. For instance, did you imagine some kind of food? Did you just relax and try nothing? Or what?

____

____

____

____

____

____

____

14. Were you asked to increase or to decrease your rate of salivation?

_______Increase _______Decrease

APPENDIX C

Table 5. Salivary Responses for Individual Subjects in Experiment II

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Paired Facilitatory Group				
SB (f)	11.75	4.25	7.50	2432
JT (m)	7.88	3.20	4.68	6536
DF (m)	5.00	1.40	3.60	2784
KP (f)	6.56	2.00	4.56	3245
SW (f)	5.11	3.00	2.11	2980
AA (f)	4.14	2.20	1.94	2227
RC (m)	3.78	2.75	1.03	3981
AJ (f)	1.83	1.00	0.83	698
DB (m)	2.89	2.20	0.69	1290
NJ (f)	5.38	4.75	0.63	2040
JF (m)	3.89	3.40	0.49	2406
DG (f)	5.29	5.25	0.04	3052
RG (m)	3.44	3.40	0.04	3397
ML (m)	2.60	2.57	0.03	2854
PC (f)	3.00	3.00	0.00	1866
BW (f)	2.33	2.60	-0.27	1524
BV (m)	5.22	5.60	-0.38	3034
CD (m)	12.13	13.25	-1.12	8865

Table 5 (continued)

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Paired Inhibitory Group				
CM (m)	4.43	2.20	2.23	1803
JD (m)	8.40	6.60	1.80	6400
LA (f)	3.33	2.60	1.73	1733
LM (f)	6.57	5.00	1.57	3529
TZ (m)	3.13	2.25	0.88	4921
EA (f)	3.44	2.60	0.84	1645
BM (f)	2.33	2.20	0.13	1594
CA (f)	4.13	4.00	0.13	2508
RS (m)	3.11	3.20	-0.09	2047
MT (m)	4.50	4.60	-0.10	2491
BG (m)	4.11	4.40	-0.29	2455
MP (m)	2.33	2.67	-0.34	1359
PE (f)	1.88	2.25	-0.37	2399
CE (f)	2.44	3.00	-0.56	2284
JG (m)	2.29	3.00	-0.71	2755
MS (m)	6.89	8.00	-1.11	5162
LC (m)	1.67	2.75	-1.79	753
WC (m)	4.57	7.20	-2.63	2728

Table 5 (continued)

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Nonpaired Facilitatory Group				
KA (m)	5.14	3.00	2.14	1057
DT (m)	4.13	2.40	1.73	1745
MS (f)	4.44	3.00	1.44	2498
JH (m)	3.33	2.20	1.13	1212
DR (m)	4.50	3.40	1.10	4895
RH (m)	2.88	2.20	0.68	3470
PK (f)	2.67	2.40	0.27	4010
NM (f)	2.25	2.00	0.25	1721
VH (f)	2.83	2.67	0.16	3017
RF (f)	6.00	6.00	0.00	3589
CS (f)	1.86	2.00	-0.14	844
PR (f)	2.00	2.20	-0.20	1884
EH (f)	2.73	3.00	-0.22	4351
GJ (m)	3.33	3.67	-0.34	8000
MC (m)	4.63	5.00	-0.37	6329
TF (m)	1.86	2.75	-0.89	3407
BS (m)	2.33	3.60	-1.27	1764
DS (f)	2.33	5.00	-2.67	1745

Table 5 (continued)

Subject (Sex)	Mean Experimental Trials Salivation in Drops	Mean Dummy Trials Salivation in Drops	Difference Score	Total Salivation in Experiment in Drops
Nonpaired Inhibitory Group				
JD (m)	5.60	3.75	1.85	7684
SL (m)	3.89	2.20	1.69	3146
LN (f)	3.56	2.50	1.06	3182
CC (f)	5.89	5.00	0.89	3492
SN (m)	2.67	2.20	0.47	3167
GG (m)	2.67	2.20	0.47	2370
BH (m)	3.00	3.00	0.00	2221
FJ (f)	3.44	3.60	-0.14	5375
BL (m)	2.40	2.75	-0.35	1548
DH (f)	1.38	1.80	-0.42	1730
GV (m)	3.00	3.60	-0.60	1622
TB (m)	2.33	3.00	-0.67	3443
GJ (m)	2.13	2.80	-0.67	1583
CO (f)	2.00	3.00	-1.00	964
KF (f)	3.56	5.40	-1.84	6006
LJ (f)	2.00	4.00	-2.00	1907
JH (m)	2.13	8.00	-5.87	3487
MG (m)	4.50	15.00	-10.50	4615

APPENDIX D

Table 6. Mean Group Responses on Questionnaire Items

Item	PF Group	PI Group	NF Group	NI Group
1	8.35	6.94	8.00	5.94
2	6.18	5.31	6.22	5.56
3	2.94	2.44	2.56	2.89
4	4.94	4.00	4.50	4.83
5	3.53	3.13	2.67	3.50
6	8.29	5.00	4.89	6.56
7	1.76	2.19	2.89	3.33
8	7.82	8.13	6.56	6.94
9	0.76	1.38	1.44	3.00
10	6.06	5.50	5.11	5.28
11	8.47	6.63	7.44	6.11
12	5.82	3.44	5.00	1.83

APPENDIX D

Table 7. Within-Group Differences in the Questionnaire Responses of High versus Low Salivary Responders

Item	PF Group z Scores	PI Group z Scores	NF Group z Scores	NI Group z Scores
1	0.99	1.33	1.12	-1.71+
2	1.03	1.81+	-0.93	0.46
3	0.90	-0.22	0.50	1.43
4	1.42	1.80+	2.06*	0.90
5	2.05*	1.10	0.72	1.12
6	1.81+	0.11	-0.78	-0.77
7	1.46	-1.18	0.05	1.66+
8	-1.87+	1.73+	-0.71	-0.76
9	0.96	-0.05	0.52	2.67#
10	1.03	-1.18	0.54	0.27
11	-1.03	-1.01	-0.18	-0.99
12	2.18*	0.05	-0.99	1.23

+ $p < .1$ two-tailed
* $p < .05$ two-tailed
# $p < .01$ two-tailed

REFERENCES

REFERENCES

Bridger, W., and Mandel, I. J. Abolition of the PRE by instructions in GSR conditioning. *J. exp. Psychol.*, 1965, *69*, 476-482.

Chauncey, H. H., and Shannon, I. L. Parotid gland secretion rate as a method for measuring response to gustatory and masticatory stimuli in humans. *Rep. Sch. of Aviation Med.*, Randolph AFB, Texas, 1959.

Cook, S. W., and Harris, R. E. The verbal conditioning of the galvanic skin reflex. *J. exp. Psychol.*, 1937, *21*, 202-210.

Crider, A., Shapiro, D., and Tursky, B. Reinforcement of spontaneous electrodermal activity. *J. comp. physiol. Psychol.*, 1966, *61*, 2027.

Dixon, W. J., and Massey, F. J. *Introduction to statistical analysis*. New York: McGraw-Hill, 1957.

Feather, B. W. Human salivary conditioning. In G. A. Kimble (Ed.), *Foundations of conditioning and learning*. New York: Appleton-Century-Crofts, 1967. Pp. 117-143.

Feather, B. W., Delse, F. C., and Bryson, M. R. Human salivary conditioning: Effect of unconditioned stimulus intensity. *J. exp. Psychol.*, 1967, in press.

Feather, B. W., and Wells, D. T. Effects of concurrent motor activity on the unconditioned salivary reflex. *Psychophysiology*, 1966, *2*, 338-343.

Finesinger, J. E., Sutherland, G. F., and McGuire, F. F. The positive conditional salivary reflex in psychoneurotic patients. *Amer. J. Psychiat.*, 1942, *99*, 61-74.

Fowler, R. L., and Kimmel, H. D. Operant conditioning of the GSR. *J. exp. Psychol.*, 1962, *63*, 563-567.

Fowler, W. R. The interstimulus interval and schedule of reinforcement in eyelid conditioning. Unpublished doctoral dissertation, Duke University, 1964.

Gormezano, I., and Moore, J. W. Effects of instructional set and UCS intensity on the latency, percentage, and form of the eyelid response. J. exp. Psychol., 1962, 63, 487-494.

Grings, W. W., and Lockhart, R. A. Effects of anxiety-lessening instructions and differential set development on the extinction of the GSR. J. exp. Psychol., 1963, 66, 292-299.

Hill, Frances A. The effects of instructions and S's need for approval on the conditioned galvanic skin response. Dissert. Abstr., 1966, 26, 6870-6871.

Kerr, A. C. The physiological regulation of salivary secretions in man. New York: Pergamon, 1961.

Kimble, G. A. Attitudinal factors in eyelid conditioning. In G. A. Kimble (Ed.), Foundations of conditioning and learning. New York: Appleton-Century-Crofts, 1967. Pp. 642-659.

Kimble, G. A. The definition of learning and some useful distinctions. In G. A. Kimble (Ed.), Foundations of conditioning and learning. New York: Appleton-Century-Crofts, 1967. Pp. 82-99.

Kimmel, Ellen, and Kimmel, H. D. A replication of operant conditioning of the GSR. J. exp. Psychol., 1963, 65, 212-213.

Li, J. C. R. Introduction to statistical inference. Ann Arbor, Mich.: Edwards, 1957.

Miller, J. The effect of facilitatory and inhibitory attitudes on eyelid conditioning. Unpublished doctoral dissertation, Yale University, 1939. Cited by G. A. Kimble (Ed.), Hilgard and Marquis' conditioning and learning. New York: Appleton-Century-Crofts, 1961. Pp. 104-105.

Miller, N. E., and Carmona, A. Modification of a visceral response, salivation in thirsty dogs, by instrumental training with water reward. J. comp. physiol. Psychol., 1967, 63, 1-6.

Mowrer, O. H. Preparatory set (expectancy)--a determinant in motivation and learning. Psychol. Rev., 1938, 45, 62-91.

Nicholls, Margaret F., and Kimble, G. A. Effect of instructions upon eyelid conditioning. J. exp. Psychol., 1964, 67, 400-402.

Norris, Eugenia B., and Grant, D. A. Eyelid conditioning as affected by verbally induced inhibitory set and counterreinforcement. Amer. J. Psychol., 1948, 61, 37-49.

Razran, G. H. Conditioned responses: An experimental study and a theoretical analysis. *Arch. Psychol. N. Y.*, 1935, *28*, No. 191.

Smith, K. Conditioning as an artifact. In G. A. Kimble (Ed.), *Foundations of conditioning and learning*. New York: Appleton-Century-Crofts, 1967. Pp. 100-111.

Winer, B. J. *Statistical principles of experimental design*. New York: McGraw-Hill, 1962.

Winsor, A. L. Factors which indirectly affect parotid secretion. *J. exp. Psychol.*, 1930, *13*, 423-437.

Woodworth, R. S., and Schlosberg, H. *Experimental psychology*. New York: Holt, Rinehart and Winston, 1954.

BIOGRAPHICAL NOTE

Date of Birth:	January 28, 1930
Place of Birth:	Durham, North Carolina
Education:	The College of Wooster, Wooster, Ohio, 1947-51 B.A., June, 1951 Duke University, Durham, North Carolina September, 1962-
Positions:	Research Assistant, Department of Psychology, Duke University, 1965-1967
Memberships:	American Association for the Advancement of Science, Society for Psychophysiological Research

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